

WHAT IS CLAIMED IS:

1. A liquid automatic dishwashing detergent comprising at least one detergent enzyme, wherein said detergent has a pH value less than 7.0.
- 5 2. The detergent of claim 1, wherein said detergent is free of chlorine sources.
3. The detergent of claim 1, wherein said detergent is free of phosphate builders.
- 10 4. The detergent of claim 1, wherein said detergent enzyme comprises a protease.
5. The detergent of claim 4, wherein said protease remains greater than 90 percent active after incubating said detergent at 30°C for one week.
- 15 6. The detergent of claim 4, wherein said protease remains greater than 80 percent active after incubating said detergent at 30°C for two weeks.
7. The detergent of claim 1, wherein said detergent enzyme comprises an amylase.
- 20 8. The detergent of claim 7, wherein said amylase remains greater than 35 percent active after incubating said detergent at 30°C for one week.
9. The detergent of claim 7, wherein said amylase remains greater than 30 percent active after incubating said detergent at 30°C for two weeks.
- 25 10. The detergent of claim 1, wherein 100 grams of said detergent cleans glasses such that said glasses have a grade value less than about 2.50 for spots after performing a standard wash test with 200 grams of Lemon Cascade Gel being used as a control set to a reference grade value of 1.90.

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11. The detergent of claim 1, wherein 100 grams of said detergent cleans flatware such that said flatware has a grade value less than about 2.50 for spots after performing a standard wash test with 200 grams of Lemon Cascade Gel being used as a control set to a reference grade value of 2.10.

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12. The detergent of claim 1, wherein 100 grams of said detergent cleans white plates such that said white plates have a grade value less than about 2.50 for spots after performing a standard wash test with 200 grams of Lemon Cascade Gel being used as a control set to a reference grade value of 1.70.

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13. The detergent of claim 1, wherein 100 grams of said detergent cleans gold plates such that said gold plates have a grade value less than about 2.50 for spots after performing a standard wash test with 200 grams of Lemon Cascade Gel being used as a control set to a reference grade value of 1.80.

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14. The detergent of claim 1, wherein 100 grams of said detergent cleans glasses such that said glasses have a grade value less than about 2.50 for film after performing a standard wash test with 200 grams of Lemon Cascade Gel being used as a control set to a reference grade value of 1.90.

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15. The detergent of claim 1, wherein 100 grams of said detergent cleans flatware such that said flatware has a grade value less than about 2.50 for film after performing a standard wash test with 200 grams of Lemon Cascade Gel being used as a control set to a reference grade value of 1.90.

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16. The detergent of claim 1, wherein 100 grams of said detergent cleans white plates such that said white plates have a grade value less than about 2.50 for film after performing a standard wash test with 200 grams of Lemon Cascade Gel being used as a control set to a reference grade value of 1.60.

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17. The detergent of claim 1, wherein 100 grams of said detergent cleans gold plates such that said gold plates have a grade value less than about 2.50 for film after performing a standard wash test with 200 grams of Lemon Cascade Gel being used as a control set to a reference grade value of 1.80.
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18. The detergent of claim 1, wherein said pH value is from about 4.5 to about 6.5.
19. The detergent of claim 1, wherein said pH value is from about 5.0 to about 6.5.
- 10 20. The detergent of claim 1, wherein said pH value is from about 4.5 to about 6.0.
21. The detergent of claim 1, wherein said pH value is from about 5.0 to about 6.0.
22. The detergent of claim 1, wherein said detergent comprises at least one pH
15 adjusting agent such that said detergent has said pH value.
23. The detergent of claim 1, wherein said enzyme comprises from about 0.01 percent to about 10.0 percent of said detergent by weight.
- 20 24. The detergent of claim 1, wherein said enzyme comprises from about 0.05 percent to about 5.0 percent of said detergent by weight.
- 25 25. The detergent of claim 1, wherein said enzyme comprises an enzyme selected from the group consisting of Alcalase™, Esperase™, Maxacal, Maxapem, Maxatase, Opticlean, Optimase, and Savinase.
26. The detergent of claim 1, wherein said detergent is thixotropic.
27. The detergent of claim 1, wherein said detergent comprises at least one
30 thixotropic thickener.

28. The detergent of claim 27, wherein said thickener comprises from about 0.05 percent to about 10.0 percent of said detergent by weight.
29. The detergent of claim 27, wherein said thickener comprises from about 0.2 percent to about 5.0 percent of said detergent by weight.
30. The detergent of claim 27, wherein said thickener comprises from about 0.5 percent to about 5.0 percent of said detergent by weight.
31. The detergent of claim 27, wherein said thickener is selected from the group consisting of cross-linked polycarboxylate polymers and xanthan gums.
32. The detergent of claim 1, wherein said detergent comprises at least one low foaming nonionic surfactant.
33. The detergent of claim 32, wherein said surfactant comprises from about 0.01 percent to about 20.0 percent of said detergent by weight.
34. The detergent of claim 32, wherein said surfactant comprises from about 0.05 percent to about 5.0 percent of said detergent by weight.
35. The detergent of claim 32, wherein said surfactant comprises a surfactant selected from the group consisting of:
- (a) first condensation products, wherein said first condensation products are condensates from a first mixture containing about one mole of a straight or branched chain fatty alcohol or acid and from about four to about forty moles of ethylene oxide, wherein said alcohol or acid is saturated or unsaturated, and wherein the chain of said alcohol or acid contains from about ten to about twenty carbon atoms;
- (b) second condensation products, wherein said second condensation products are condensates from a second mixture containing about one mole of alkyl phenol and from

about four to about fifty moles of ethylene oxide, wherein the alkyl chain of said alkyl phenol contains from about eight to about eighteen carbon atoms;

(c) polyoxypropylene, polyoxyethylene condensates having the formula $R_1O(CH_2CH_2O)_x(CH(CH_3)CH_2O)_yR_2$, wherein R_1 is H or an alkyl group having from one to four carbon atoms, wherein R_2 is H or an alkyl group having from one to four carbon atoms, wherein x is an integer greater than or equal to one, wherein y is an integer greater than or equal to one, wherein the total C_2H_4O content is from about 20 percent to about 90 percent of the total weight of said polyoxypropylene, polyoxyethylene condensates, and wherein the molecular weight of said polyoxypropylene, polyoxyethylene condensates is from about 2000 Daltons to about 10,000 Daltons; and

(d) capped condensates, wherein said capped condensates comprise said polyoxypropylene, polyoxyethylene condensates capped with at least one capping molecule, said capping molecule being selected from the group consisting of propylene oxide, butylene oxide, short chain alcohols, and short chain fatty acids.

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36. The detergent of claim 1, wherein said detergent comprises at least one calcium ion source.

37. The detergent of claim 36, wherein said calcium ion source comprises from about 0.01 percent to about 5.0 percent of said detergent by weight.

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38. The detergent of claim 1, wherein said detergent comprises at least one enzyme stabilizer.

39. The detergent of claim 38, wherein said enzyme stabilizer comprises from about 0.01 percent to about 30.0 percent of said detergent by weight.

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40. The detergent of claim 38, wherein said enzyme stabilizer is selected from the group consisting of propylene glycol, sorbitol, fructose, sucrose, glucose, short chain carboxylic acids, salt forms of short chain carboxylic acids, polyhydroxyl compounds,

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boric acid, soluble salt forms of boric acid, boronic acid, and soluble salt forms of boronic acid.

5 41. The detergent of claim 1, wherein said detergent comprises at least one non-phosphate detergent builder.

42. The detergent of claim 41, wherein said non-phosphate detergent builder comprises from about 0.5 percent to about 30.0 percent of said detergent by weight.

10 43. The detergent of claim 41, wherein said non-phosphate detergent builder comprises from about 1.0 percent to about 20.0 percent of said detergent by weight.

15 44. The detergent of claim 41, wherein said non-phosphate detergent builder is selected from the group consisting of citric acid, alkali metal forms of citric acid, and ammonium salt forms of citric acid.

45. The detergent of claim 1, wherein said detergent comprises at least one organic dispersant.

20 46. The detergent of claim 45, wherein said dispersant comprises from about 0.5 percent to about 30.0 percent of said detergent by weight.

25 47. The detergent of claim 45, wherein said dispersant comprises from about 1.0 percent to about 20.0 percent of said detergent by weight.

48. The detergent of claim 45, wherein said dispersant is a soluble salt of a polymer or copolymer of acrylic acid.

30 49. The detergent of claim 45, wherein said dispersant is a mixture of soluble salts of one or more acrylic acid polymers or copolymers having a molecular weight less than

about 5,000 Daltons and one or more acrylic acid polymers or copolymers having a molecular weight of greater than about 500,000 Daltons.

50. The detergent of claim 1, wherein said detergent comprises a mixture of at least one non-phosphate detergent builder and at least one organic dispersant.

51. The detergent of claim 50, wherein said mixture comprises from about 0.5 percent to about 30.0 percent of said detergent by weight.

10 52. The detergent of claim 1, wherein said detergent comprises, by weight:
(a) from about 0.05 percent to about 10.0 percent of a thixotropic thickener,
(b) from about 0.00 percent to about 20.0 percent of a low foaming nonionic
surfactant,
(c) from about 0.01 percent to about 10.0 percent of said enzyme, said enzyme
15 being a protease,
(d) from about 0.01 percent to about 5.0 percent of a calcium ion source,
(e) from about 0.00 percent to about 30.0 percent of an enzyme stabilizer,
(f) from about 0.5 percent to about 30.0 percent of a non-phosphate detergent
builder, an organic dispersant, or mixture thereof,
20 (g) a sufficient amount of a pH adjusting agent such that said detergent has said
pH value.

53. The detergent of claim 1, wherein said detergent comprises, by weight:
(a) from about 0.5 percent to about 5.0 percent of a thixotropic thickener,
25 (b) from about 0.05 percent to about 5.0 percent of a low foaming nonionic
surfactant,
(c) from about 0.05 percent to about 5.0 percent of said enzyme, said enzyme
being a protease,
(d) from about 0.01 percent to about 1.0 percent of a calcium ion source,
30 (e) from about 0.5 percent to about 10.0 percent of an enzyme stabilizer,

(f) from about 1.0 percent to about 20.0 percent of a non-phosphate detergent builder,

(g) from about 1.0 percent to about 20.0 percent of a soluble salt of a polymer or copolymer of acrylic, and

5 (h) a sufficient amount of a pH adjusting agent such that said detergent has a pH value from about 5.0 to about 6.5.

54. The detergent of claim 1, wherein said detergent comprises, by weight, about 55 percent water; about 7 percent citric acid; about 5 percent propylene glycol; about 2
10 percent Carbopol™ 676; about 8 percent NaOH, 50% aq.; about 1 percent sodium borate pentahydrate; about 2 percent sodium citrate; about 2 percent sodium formate; about 0.1 percent calcium chloride; about 5 percent sodium xylene sulfonate, 40% aq.; about 2 percent Pluronic™ 25R2; about 10 percent Burcosperse™ AP; about 1 percent Savinase™ 16.0L; and about 0.1 percent Surcide P.

15 55. A method of cleaning tableware in an automatic dishwashing machine, said method comprising dispensing an effective amount of a liquid automatic dishwashing detergent into the dispensing cup of said machine, said detergent comprising at least one detergent enzyme, and said detergent having a pH value less than 7.0.

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